Work Plan Addendum

for

Outpost Monitoring Well Installation Program

Naval Weapons Industrial Reserve Plant

Bethpage, New York

Engineering Field Activity Northeast
Naval Facilities Engineering Command

Contract Number N62467-94-D-0888

Contract Task Order 0812

February 2003

Revision 2 - July 2003

TETRA TECH NUS, INC.

010304/P

WORK PLAN ADDENDUM
FOR
OUTPOST MONITORING WELL INSTALLATION PROGRAM

NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BETHPAGE, NEW YORK

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Engineering Field Activity Northeast
Environmental Branch Code EV2
Naval Facilities Engineering Command
10 Industrial Highway, Mail Stop #82
Lester, Pennsylvania 19113-2090

Submitted by:
Tetra Tech NUS, Inc.
600 Clark Avenue, Suite 3
King of Prussia, Pennsylvania 19406-1433

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0812

JULY 2003

PREPARED UNDER DIRECTION OF:

DAVID D. BRAYACK
PROJECT MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

APPROVED FOR SUBMISSION BY:

JOHN J. TREPANOWSKI
PROGRAM MANAGER
TETRA TECH NUS, INC.
KING OF PRUSSIA, PENNSYLVANIA

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1.0 INTRODUCTION AND OVERVIEW

Tetra Tech NUS, Inc. (TtNUS) has been contracted to perform a subsurface investigation for the Department of Navy, Engineering Field Activity Northeast (EFANE) at and near the Naval Weapons Industrial Reserve Plant (NWIRP) in Bethpage New York (hereinafter referred to as the site). Since 1994, Northrop Grumman, the U.S. Navy, and the New York State Department of Environmental Conservation (NYSDEC) have been working together to address the regional groundwater contamination issues associated with historic NWIRP Bethpage and Northrop Grumman Corporation operations.

A Record of Decision (ROD) was published by the Navy in April 2003 that identified a series of actions be taken by the Navy to address groundwater contamination that lies beneath and to the south of their respective properties.

As a result, several vertical profile borings were installed to delineate the southern boundary of a groundwater contaminant plume. The sampling data from these borings were used to locate the proposed well clusters to be installed as part of this program. This document is the work plan for the outpost monitoring well program, which will include the drilling and installation of 9 monitoring wells at 4 locations off the Navy property. The drilling locations are shown on Figure 1 and are further detailed in Figures 2 and 3. A summary of the drilling program is included in Table 1. Figures and tables are provided at the end of the document.

This section provides an introduction and overview of the program. Section 2 describes the necessary tasks to complete the fieldwork activities.

Monitoring wells will be installed to different depths, which are classified as Deep (D), Deep 2 (D2), and Deep 3 (D3), as defined below.

- Deep (D) zone -50 to -365 ft msl.
- Deep 2 (D2) zone -365 to -530 ft msl.
- Deep 3 (D3) zone -530 to -680 ft msl.

The wells will be installed in clusters, and drilled, installed, and developed in the following general order, however, site-specific conditions may cause the sequence to be modified:

1. Drill the deepest boring and collect split-spoon samples.

2. Gamma Log the deepest boring.

3. Install the deepest well (includes setting the screen and installing the backfill materials, seals, and locking protective casing), see Attachment 1.

4. Drill and install the remaining shallow wells in the cluster, collecting split spoon samples as described in Section 2.

5. Develop wells.

2.0 FIELD INVESTIGATION TASKS

The tasks that are necessary to complete the field activities are described in this section.

2.1 MOBILIZATION/DEMOBILIZATION

The subsurface investigation will be performed by TtNUS, with support from subcontractors for drilling, investigation derived waste (IDW) disposal, and surveying activities. The supervisor of the team will be a TtNUS representative, who will be identified as the Field Operations Leader (FOL). Additional TtNUS staff will be on-site as needed, and the subcontractor staff will vary from one individual for IDW activities upwards to several people for drilling activities.

It should be noted that the drilling sites are on publicly owned property lots. Access to the lots will be obtained and coordinated by the Navy.

The TtNUS FOL will obtain the necessary equipment for completion of the fieldwork, including setting up the command post. Health and Safety training will be conducted for all site personnel, including maintaining all necessary documentation and ensuring compliance in accordance with the Health and Safety Plan and the subcontract documents. Locations will be cleared of utilities prior to drilling.

2.2 DRILLING ACTIVITIES

Drilling activities will be performed using mud rotary drilling techniques. A boring log will be maintained for each boring drilled.

2.2.1 Mud Rotary Drilling

The well boring diameters will be at least 8 inches to provide sufficient annular space for the installation of 4 inch-diameter wells. A smaller diameter pilot hole can be drilled during soil sampling, however, the boring must be reamed with a larger drill bit prior to well installation. The drill bit and drill rods shall be the type to accommodate split spoon sampling through the drill string. A multi-baffle chamber, high capacity mud pan or dug mud pit will be used to hold drilling mud during the drilling activity. The injection of water and polymer-free bentonite drilling mud is allowed. All lubricants that will potentially come in contact with the drilling mud will be of food grade quality. The use of any other types of additives is prohibited without prior approval of the TtNUS Project Manager.

2.3 SOIL/GROUNDWATER SAMPLING

Soil samples will be collected from the each of the well borings for lithologic descriptive purposes. The soil samples will be collected using split spoon samplers according to American Society for Testing and Materials (ASTM) D-1586 methods. In the deepest boring at each cluster soil samples will be collected at 100 foot intervals throughout the boring. For the other borings in each cluster soil samples will not be collected. Since drilling techniques for the permanent monitoring wells are different than for profile borings, vertical profile boring-type groundwater samples will normally not be collected during the installation of the outpost monitoring wells. However, if based on the boring lithology data, a target screen interval is determined to consist primarily of fine-grained material not appropriate for setting a well screen, then groundwater samples will be collected, in accordance with the Outpost Monitoring Well Drilling Contingency Procedures presented in Attachment 1, to aid in the selection of an alternative screen zone.

A groundwater sample will be collected during the final purge of each outpost monitoring well. This sample will be collected by reducing the discharge rate of the submersible pump to a minimum and then directly filling sample vials from the tubing discharge. The sample will be analyzed for VOCs. This data is considered to be semi-quantitative and will only be used as an initial screen of the quality of the water in the well.

2.4 NATURAL GAMMA LOGGING

Downhole natural gamma logging will be performed by the drilling subcontractor in the Outpost Well borings as shown on Table 1. Upon reaching the final depth of the boring, the downhole drilling equipment will be removed, and gamma logging will be performed from the land surface to the total depth of the boring. The results of the logging will be evaluated by TtNUS and Arcadis Geraghty and Miller (Northrop Grumman) and will be used in combination with split spoon sample observations to determine exact well screen placements.

2.5 MONITORING WELL INSTALLATION

Monitoring wells will be installed with the screen intervals shown on Table 1. A typical well construction detail is provided in Figure 4. The well screen and riser pipe will be lowered into the open hole after the drilling mud is thinned to the fullest extent possible without resulting in excessive caving. The mud rotary borings will also be reamed along the screened interval, prior to well installation to remove as much drilling mud as possible. The depths of all backfilled materials will be constantly monitored during the well installation process by means of a wire-line measuring device.

The outpost wells will be constructed of 4-inch diameter, schedule 80 National Sanitation Foundation (NSF)-grade Polyvinyl Chloride (PVC) well casing and screen. Only materials meeting American Petroleum Institute (API) and ASTM water well standards will be used. All well screens (slotted construction) will be 10 slot (0.010 inches). A vented PVC well cap and threaded PVC bottom cap will be installed on each well. All riser and screen sections will be flush-joint, internally-threaded. Joints will be made up so that when tight, all threads are buried within the riser walls. No couplings, solvents, glues, or chemical cleaners will be used in well construction.

After setting the well screen and casing, the gravel pack (W.G. No. 1) will be placed within the boring annulus, to a depth as identified in Table 1. The well gravel will be placed as follows:

- Deep (D) Wells: to a minimum of 10 feet above the top of the screen.
- Deep 2 (D2) Wells: to a minimum of 20 feet above the top of the screen.
- Deep 3 (D3) Wells: to a minimum of 25 feet above the top of the screen.

The gravel pack will be carefully placed into the annulus through a tremie pipe and its depth will be carefully checked during placement to be sure that it has not bridged. A fine sand layer (finer than gravel pack) will be placed in the annulus on top of the gravel pack in the same manner as the gravel pack, as follows:

- Deep (D) Wells: 5 feet thick above the top of the gravel pack.
- Deep 2 (D2) Wells: 10 feet thick above the top of the gravel pack.
- Deep 3 (D3) Wells: 15 feet thick above the top of the gravel pack.

The gravel pack and fine sand thickness may be changed based on subsurface conditions. A 4- to 8-foot thick bentonite seal will be installed above the fine sand layer using a tremie pipe. The seal will consist of approximately 1.25 pounds of pure bentonite per gallon of water. A Volclay® bentonite slurry will be installed within the annular space above the bentonite seal using a tremie pipe. In all wells, the slurry will be installed to approximately 3 feet below land surface in one continuous operation. The tremie pipe will be gradually removed from the annular space as the slurry is added from the bottom up. Upon approval by the TtNUS representative a cement-bentonite slurry may also be used within the annular space at depths no deeper than 100 feet below ground surface.

Wells will be completed at grade by cementing a 12-inch diameter, locking curb box in place over the wells. A fine sand will be installed above the top of the bentonite slurry and inside the curb box to permit any water which may accumulate inside the curb box to drain. A 0.5 foot thick concrete apron measuring

2 feet by 2 feet square will be placed around each well. Keyed alike well locks will be used to secure the wells. A typical well detail is provided on Figure 4.

2.6 MONITORING WELL DEVELOPMENT

The monitoring wells will be developed no sooner than 24 hours after installation to remove fine materials and sediments from the area around the well screens, and to remove drill cuttings and residual fluids from the area around the monitored interval of the boring.

Monitoring wells will be developed using a combination of air lift and mechanical surging. A threaded, 2-inch diameter steel eductor pipe with a dual surge block assembly (i.e., two rubber swabs set 3 feet apart along a length of perforated steel pipe) will be installed in the well with the surge block set at the base of the well screen. A 3/4-inch diameter polyethylene airline will then be inserted in the eductor pipe to a depth above the top of the well screen. The well will be developed using the combination of air lift pumping and surging (vertical movement of the surge block in the screen zone) at 2-foot discrete intervals upwards along the entire length of the well screen. Field parameters, including pH (standard units), specific conductance [millisiemen per centimeter (mS/cm)], temperature (degrees in centigrade), and turbidity [nephelometric turbidity units (NTU)] will be monitored and recorded periodically throughout well development.

Well development will also include purging stagnant water from the well above the screen interval and rinsing the interior well casing above the water table by using only water from that well. The well will be covered with a clean well cap, which will be rinsed with distilled water prior to installation. The result of this operation will be a well casing free of extraneous materials (grout, bentonite, sand, etc.). At the end of the purging stage, the water extraction rate will be decreased and a groundwater sample will be collected from each well.

Development will continue until all traces of drilling mud are removed, and the well produces clear, sediment-free water, to the extent practical. In compliance with NYSDEC policy, every effort will be made to develop wells until turbidity (as measured in the field) is less than 50 NTUs. However, in some instances, the 50 NTU standard may not be attainable, if the observed turbidity is the result of the formation screened and not related to well design, installation, or development. Therefore, if after a "best well development effort," the 50 NTU standard cannot be attained and turbidity stabilizes (above the 50 NTU standard), the well will be considered acceptable, provided the integrity of the well is satisfactorily proven.

The development fluid will be containerized and transported to the decontamination area where it will be stored in a tank.

2.7 INVESTIGATIVE DERIVED WASTE HANDLING

All Investigative Derived Waste (IDW) accumulated during drilling activities will be collected, accumulated at the NWIRP Bethpage, and eventually disposed off site. These materials include soil cuttings, drilling mud, discharge water, development water, and decontamination water. The soil cuttings and drilling mud will be collected in 55 gallon drums by the drilling subcontractor and will be transferred to a rolloff container that is capable of separating liquids from solid materials. The separated liquids will be pumped from the rolloff container to a holding tank. The discharge waters and decontamination waters will be collected by the drilling contractor and will be transferred to the holding tank. All wastes will be staged for future characterization and disposal.

2.8 DECONTAMINATION

A centrally located decontamination pad on the NWIRP Bethpage will be used for the collection of all decontamination-generated fluids. All decontamination fluids will be collected and staged for characterization and subsequent disposal.

The decontamination operations will consist of washing drilling equipment using a high-pressure potable steam wash. The spilt spoons and the downhole groundwater sampling equipment will be decontaminated with a detergent wash, a potable water rinse, and a deionized water rinse.

2.9 SURVEYING

All newly installed monitoring wells will be surveyed by a New York State-licensed surveyor for both horizontal and vertical control. A total of three monitoring well reference points will be surveyed for vertical control, including the top of the protective casing, the top of the riser pipe, and the ground surface. The center of the well cap will be surveyed for horizontal control.

2.10 DOCUMENTATION

Documentation required to support this project will consist of the following items:

- Field Notebook
- Boring log for each boring
- Well completion form for each well
- Well development record

2.11 SPILL CONTROL MEASURES

Spills will be controlled using the measures that are defined in the Health and Safety Plan. The general process will include immediate response to contain the spill and subsequent cleanup measures to prevent any further impact to the environment.

2.12 REPORTING

A monitoring well installation summary report will be prepared and submitted as before. This report will include geologic logs, well construction diagrams, gamma logs, sample results and development data.

TABLE 1

OUTPOST MONITORING WELL
PROPOSED DRILLING AND SAMPLING SPECIFICATIONS
NWIRP BETHPAGE, NEW YORK

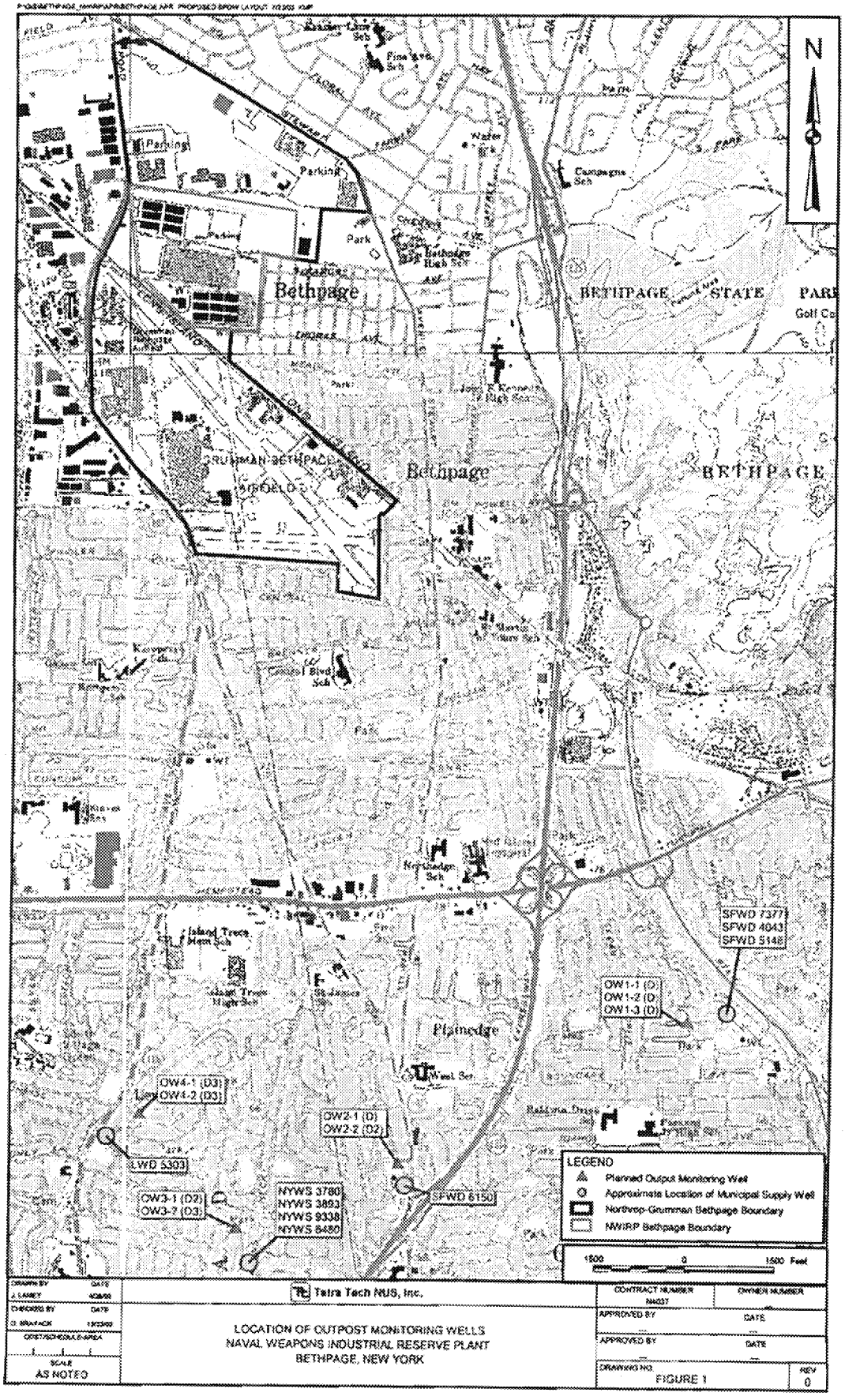
Outpost Well Designation	Screened Interval (ft bgs)[1]	Total Well Depth (ft bgs)[1]	Height Gravel Pack (ft bgs)[1]	Height Fine Sand (ft bgs)[1]	Number of Split Spoons[2]	Gamma Log	Municipal Supply Well Nos.	Municipal Well Field Monitored
OW1-1(D)	196 to 236	236	186	181	0	No	4043[3], 5148, 7377	South Farmingdale Well Field 1
OW1-2(D)	274 to 314	314	264	259	0	No	4043[3], 5148, 7377	South Farmingdale Well Field 1
OW1-3(D)	369 to 409	409	359	354	3	Yes	4043[3], 5148, 7377	South Farmingdale Well Field 1
OW2-1(D)	305 to 390	390	340	335	0	No	6150	South Farmingdale Well Field 3
OW2-2(D2)	436 to 476	476	416	406	4	Yes	6150	South Farmingdale Well field 3
OW3-1(D2)	437 to 477	477	417	407	0	No	8480[3], 9338	New York Water Service 3S and 4S
OW3-2(D3)	605 to 645	645	580	565	5	Yes	8480[3], 9338	New York Water Service 3S and 4S
OW4-1(D3)	652 to 692	692	627	612	0	No	5303	TOH Water District (Levittown) 13
OW4-2(D3)	730 to 770	770	705	690	13	Yes	5303	TOH Water District (Levittown) 13

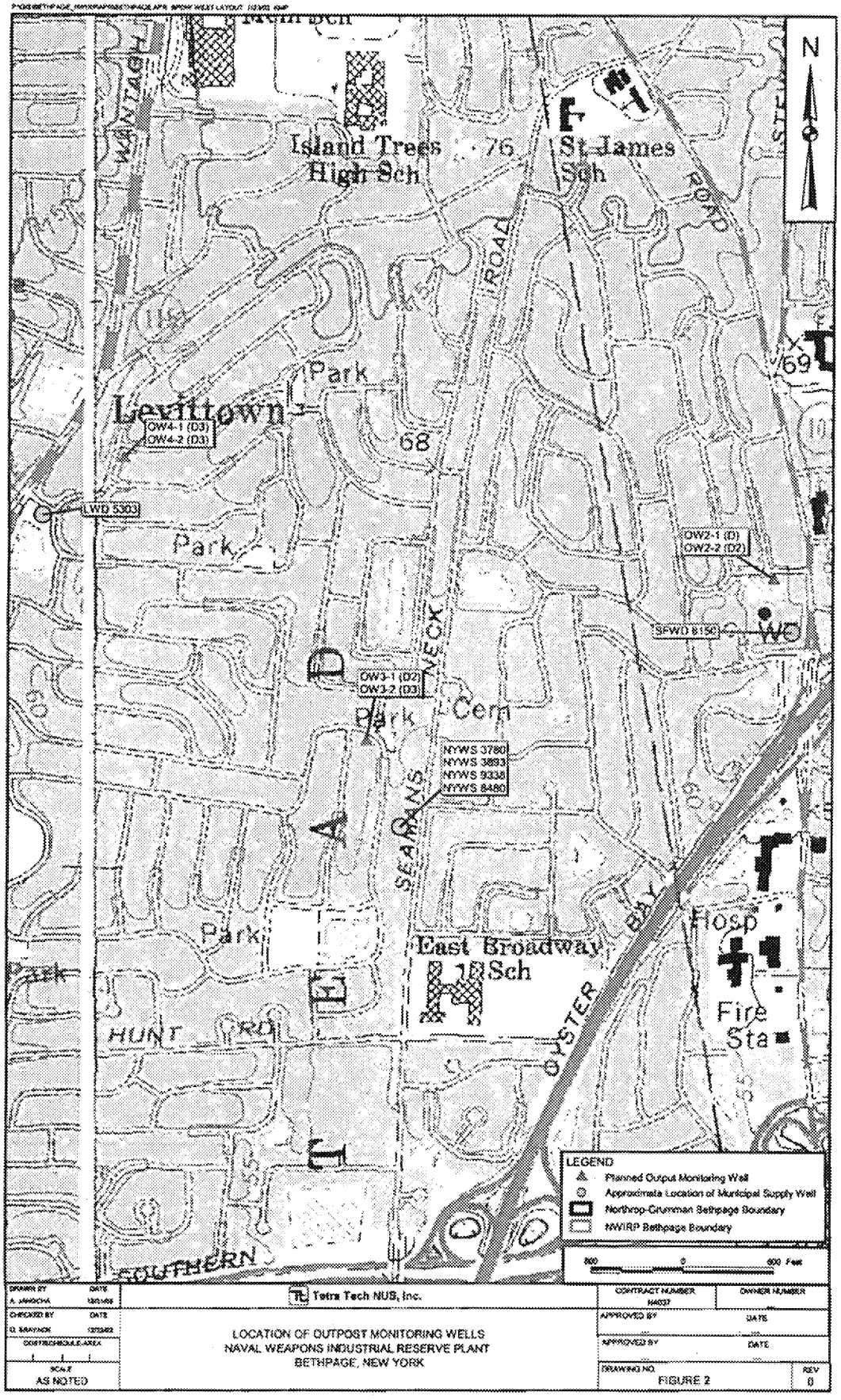
bgs - Below ground surface
ft - feet

1 Based on the local USGS quad sheet, ground surface is assumed to range from 60 to 74 feet above mean sea level. Final screen intervals will be determined in the field based on boring specific lithology.

2 In the deepest well at each cluster, split spoon samples will be collected at 50-foot intervals to approximately 20-foot above the well screen, then samples will be collected at 5-foot intervals to the bottom of the boring. For the other remaining borings at each cluster, split spoon samples will need only be collected starting at 20-foot above the well screen to the bottom of the boring. Groundwater samples will be collected during the final purge of each outpost monitoring well and analyzed for VOCs. In addition, groundwater samples may be collected during drilling of the boring in accordance with Drilling Contingency Procedures.

3 Based on modeling efforts, this well will be the first location to be impacted at the well field. The outpost monitoring wells are designed to monitor this well for impact.





DRAWN BY: A. JANKOWIA	DATE: 12/01/05	Tetra Tech NUS, Inc.	CONTRACT NUMBER: N4037
CHECKED BY: D. SANTACRI	DATE: 12/02/05		APPROVED BY: DATE:
DISTRIBUTION/SCALE AREA:		LOCATION OF OUTPOST MONITORING WELLS NAVAL WEAPONS INDUSTRIAL RESERVE PLANT BETHPAGE, NEW YORK	APPROVED BY: DATE:
SCALE: AS NOTED			DRAWING NO.: FIGURE 2 REV: 0

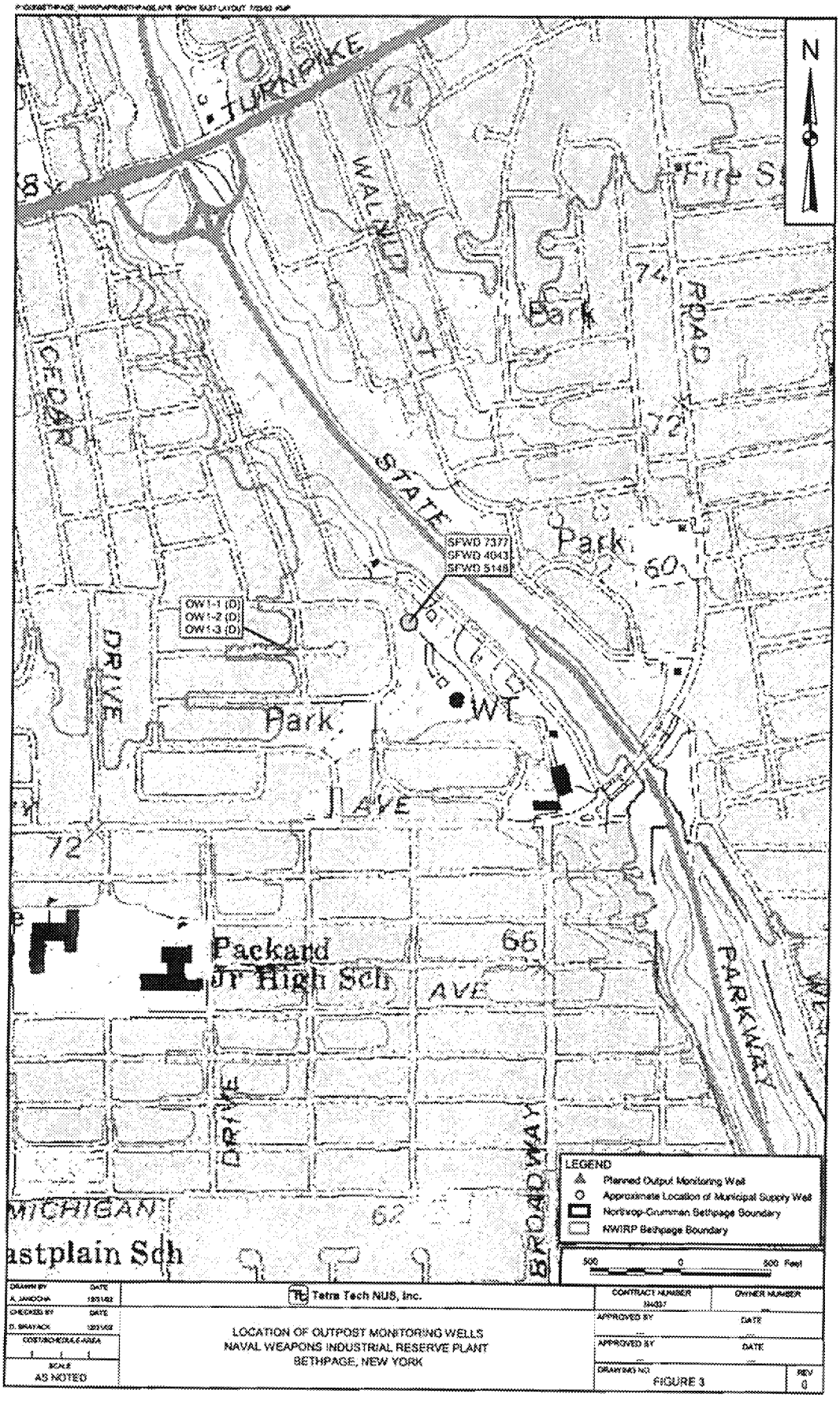


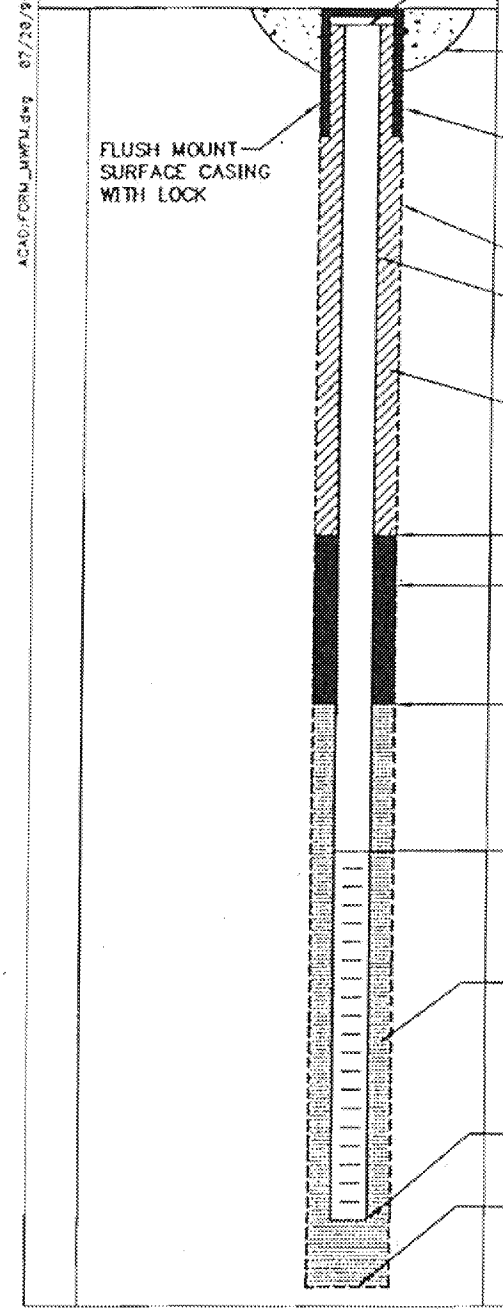
FIGURE 4
TYPICAL MONITORING WELL CONSTRUCTION

WELL NO.: _____

Tetra Tech NUS, Inc.

OVERBURDEN
MONITORING WELL SHEET
FLUSH - MOUNT

PROJECT Naval Ordnance	LOCATION	DRILLER
PROJECT NO. N4037	BORING	DRILLING METHOD Mud Rotary
DATE BEGUN	DATE COMPLETED	
FIELD GEOLOGIST		DEVELOPMENT METHOD Bail/Pump
GROUND ELEVATION	DATUM	



ELEVATION TOP OF RISER: _____

TYPE OF SURFACE SEAL: 2'x2' Cement Pad

TYPE OF PROTECTIVE CASING: Steel

I.D. OF PROTECTIVE CASING: 12"

DIAMETER OF HOLE: 8"

TYPE OF RISER PIPE: PVC-Sch.80

RISER PIPE I.D.: 3.8

TYPE OF BACKFILL/SEAL: Bent/Cement to 100' below ground surface

ELEVATION/DEPTH TOP OF SEAL: /

TYPE OF SEAL: Bentonite

ELEVATION/DEPTH TOP OF SAND: /

5' to 15' Fine Sand (WG00)
10' to 25' Coarse Sand (WG#1) above Screen

ELEVATION/DEPTH TOP OF SCREEN: /

TYPE OF SCREEN: PVC-Sched.80

SLOT SIZE x LENGTH: No 10 Slot, ~40'

TYPE OF SAND PACK: WG #1 Silica Sand

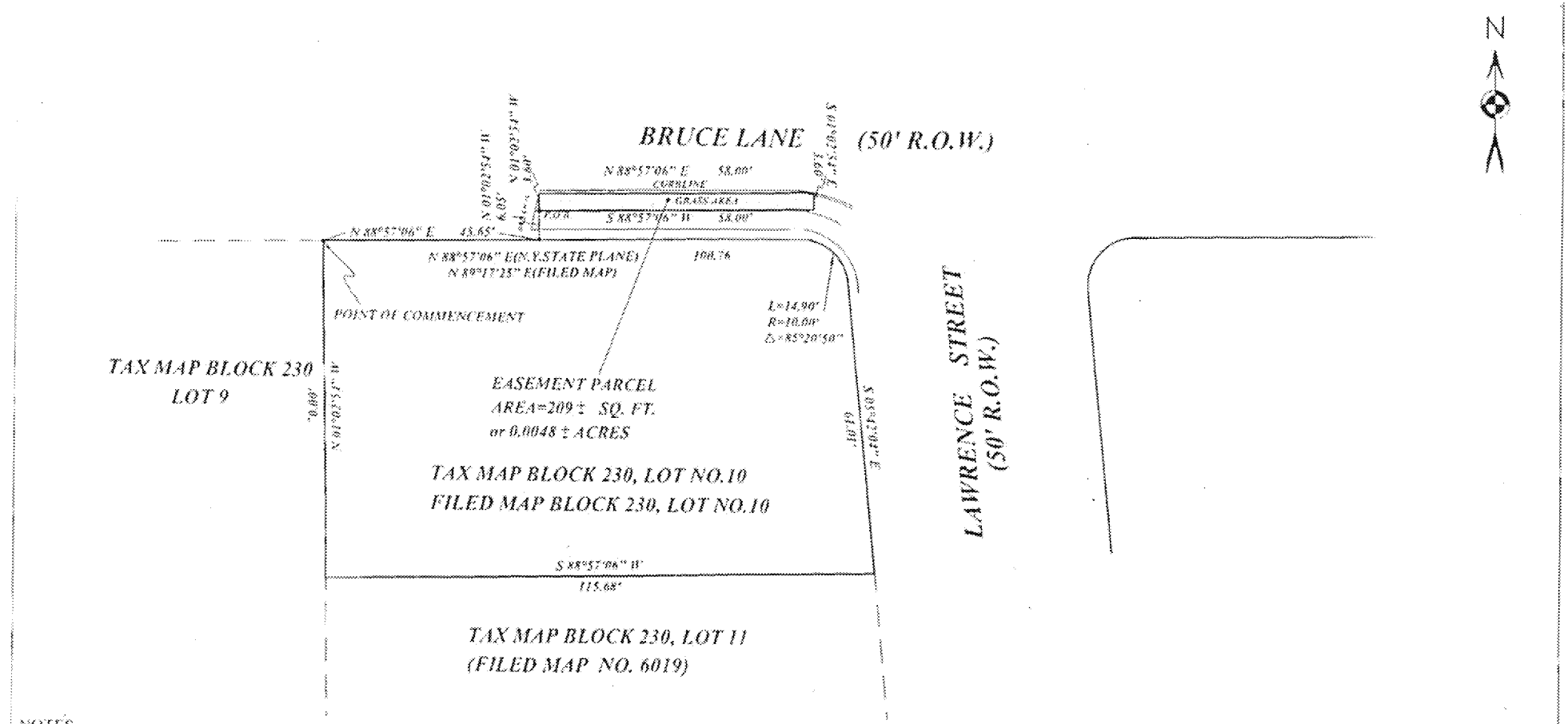
ELEVATION / DEPTH BOTTOM OF SCREEN: /

ELEVATION / DEPTH BOTTOM OF SAND: /

ELEVATION/DEPTH BOTTOM OF HOLE: /

BACKFILL MATERIAL BELOW SAND: _____

ACAD:FORM_MWFLUSH 07/28/88 INC.



NOTES

1. Tax Map Section 49, Block 230, Lot No 10
2. Bearings shown in N.Y. State Plane (NAD-83(Ma)) on the herein Easement Parcel were derived by subtracting 0° 20' 19" from Filed Map azimuth.
3. Any alteration or addition to this survey is a violation of Section 7209 of The New York State Education Law except as per Section 7209-Subdivision 2.

N/S

REFERENCES:

1. "Map of Pinehurst - Section 1..... Filed in the NCCO, Division of Land Records on September 13, 1951 as Map No. 5308.
2. "Map of Pinehurst-Section 2 ..." filed in the NCCO, Division of Land Records on Dec. 14, 1953 as Map No.6019.
3. Nassau County Land & Tax Map Block 230, Section 49 Town of Oyster Bay.

NO.	DATE	DESCRIPTION	APPR'D.
		REVISIONS	

N/S 1" = 20'

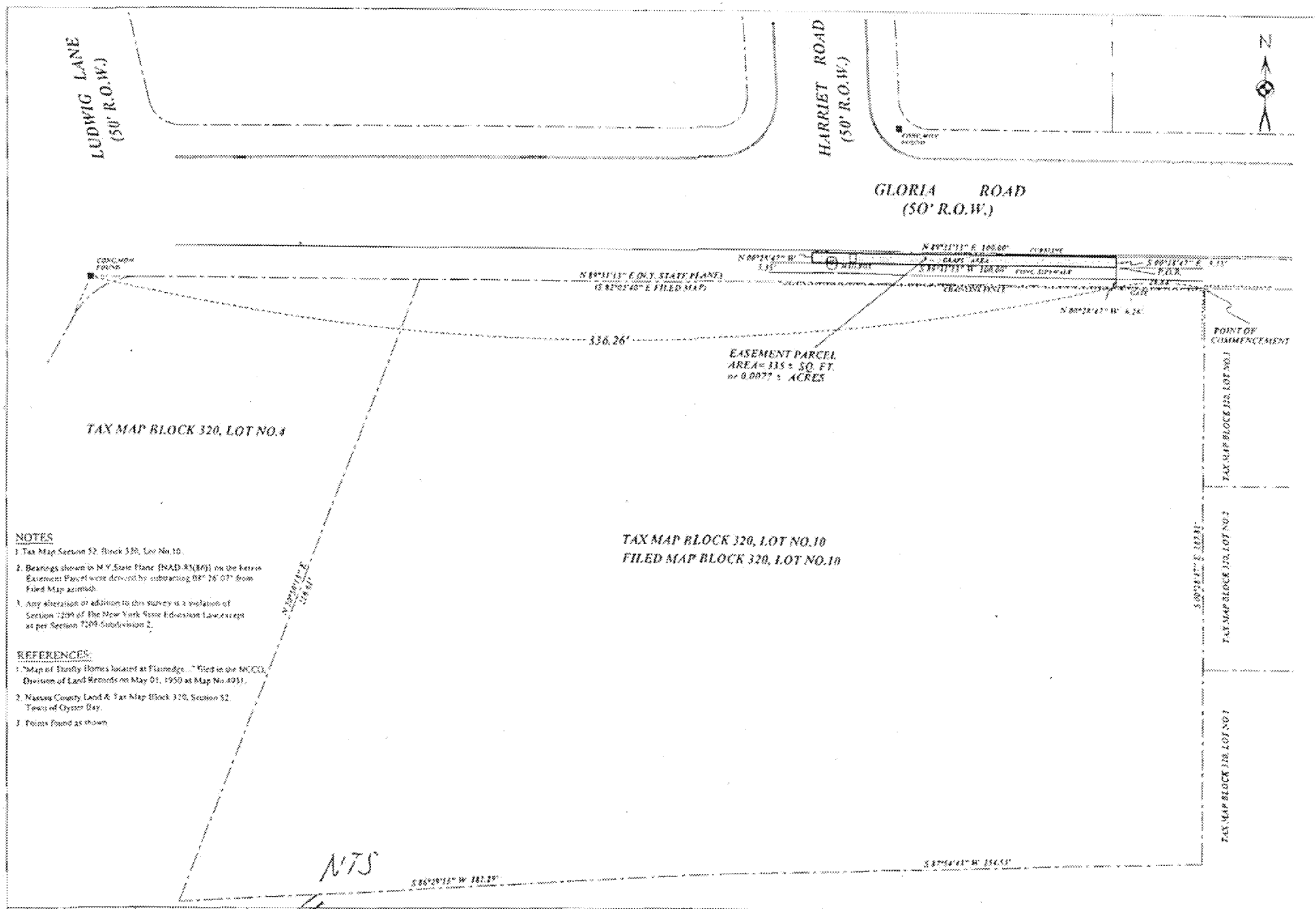
HIRANI ENGINEERING & LAND SURVEYING, P.C.
47 MINEOLA BLVD., 2ND FLOOR
MINEOLA, N.Y. 11501
T (516) 248-1616 F (516) 248-6018
H I R A N I

OWNER: U.S DEPT. OF NAVY

CONTRACTOR: TETRA TECH NUS

SUBJECT:
EASEMENT FOR OUTPOST MONITORING WELLS BP-OW 1-1 (D),BP-OW 1-2 (D) & BP-OW 1-3(D).

DATE DRAWN: 02/15/05
DATE OF SURVEY: 02/02/2005
CONTRACT NO: 2117
SHEET NO. 1 OF 1



NOTES

1. Tax Map Section 52, Block 320, Lot No.10.
2. Bearings shown in N.Y.State Plane (NAD-83(86)) on the herein Easement Parcel were derived by subtracting 08° 26' 07" from Filed Map azimuth.
3. Any alteration or addition to this survey is a violation of Section 7209 of the New York State Education Law except as per Section 7209 Subdivision 2.

REFERENCES:

1. "Map of Stanley Homes located at Plainedge..." filed in the NCCO, Division of Land Records on May 01, 1950 as Map No.4935.
2. Nassau County Land & Tax Map Block 320, Section 52 Town of Oyster Bay.
3. Points found as shown.

NO.	DATE	DESCRIPTION REVISIONS	APPR'D

DRAWN BY: R.C.P.
CHECKED BY: H.S.H.

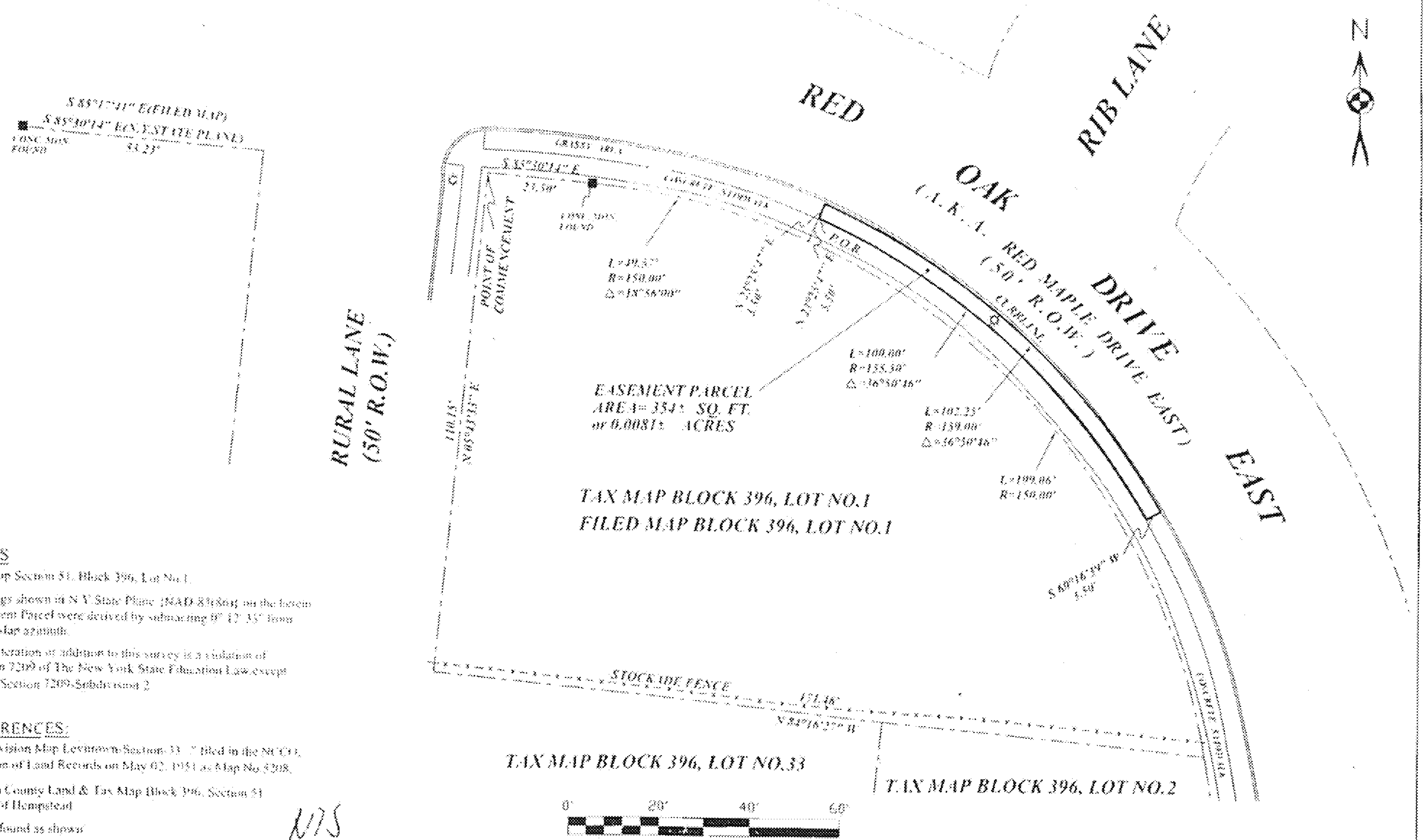
SCALE: 1"=20'

HIRANI ENGINEERING & LAND SURVEYING, P.C.
45 MINEOLA BLVD., SECOND FLOOR
MINEOLA, NY 11501
T (516) 248-1510 F (516) 248-5081 HIRANI

OWNER: U.S. DEPT. OF NAVY
CONTRACTOR: TETRA TECH NUS

SUBJECT:
EASEMENT FOR OUTPOST MONITORING WELLS
BP-OW 2-1(D) & BP-OW 2-2 (D2).

DATE DRAWN: 01/02/03
DATE SURVEYED: 01/09/03 - 01/24/03
CONTRACT #: 502-2117
SHEET NO. 1 OF 1



NOTES

1. Tax Map Section 51, Block 396, Lot No.1.
2. Bearings shown in N.Y. State Plane (NAD 83(86)) on the herein Easement Parcel were derived by subtracting 0° 12' 35" from Filed Map azimuth.
3. Any alteration or addition to this survey is a violation of Section 7209 of The New York State Education Law except as per Section 7209-Subdivision 2.

REFERENCES:

1. "Subdivision Map Levittown Section 33 ..." filed in the NCCO, Division of Land Records on May 02, 1951 as Map No. 5208.
2. Nassau County Land & Tax Map Block 396, Section 51 Town of Hempstead
3. Points found as shown

NJS

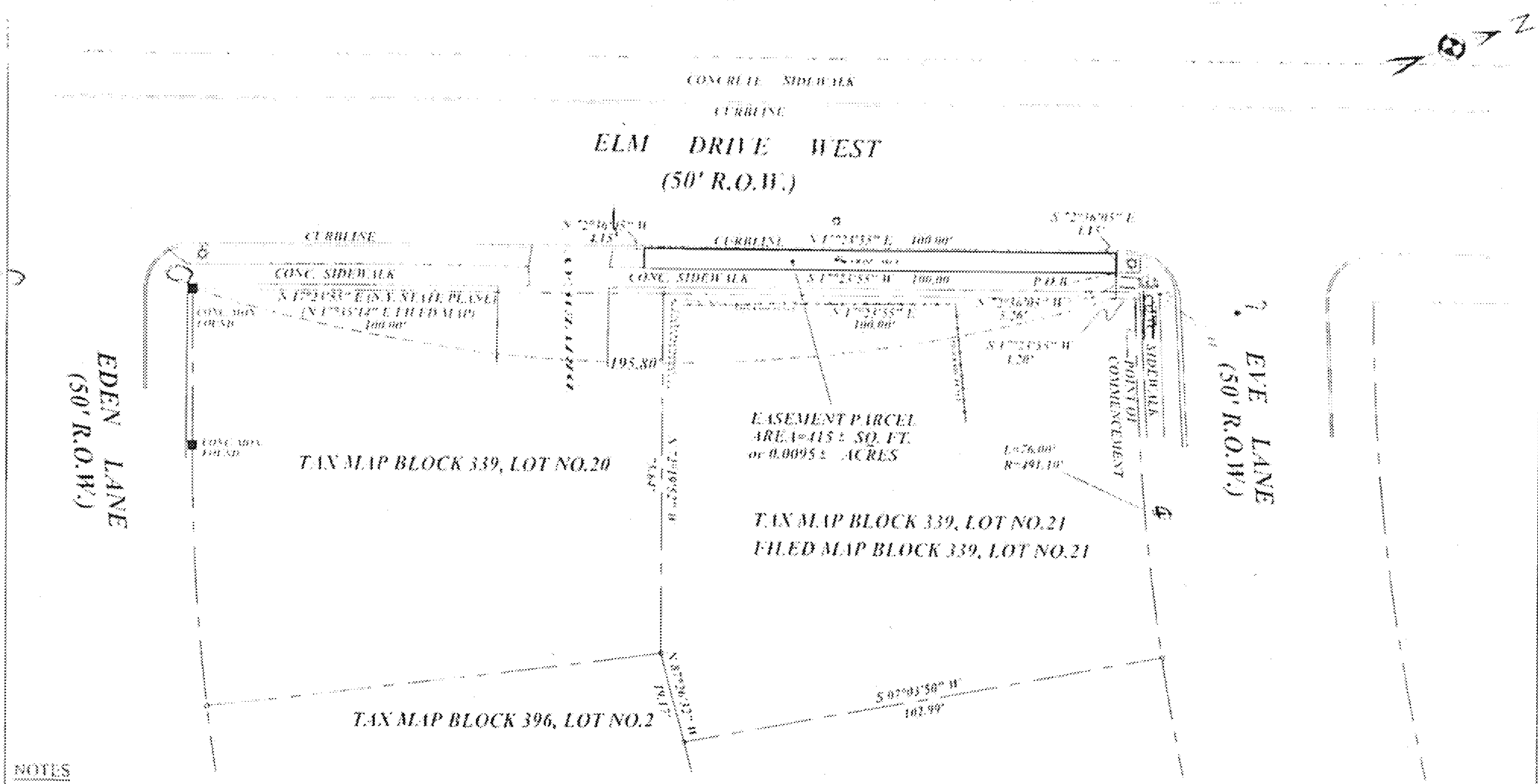
NO.	DATE	DESCRIPTION	APPR'D
		REVISIONS	

SCALE 1"=20'

HIRANI ENGINEERING & LAND SURVEYING, P.C.
HIRANI

OWNER: U.S DEPT. OF NAVY
CONTRACTOR: TETRA TECH NUS

SUBJECT: EASEMENT FOR OUTPOST MONITORING WELLS BP-OW 3-1 (D2) & BP-OW 3-2 (D3)



NOTES

1. Tax Map Section 51, Block 339, Lot No. 21
2. Bearings shown in N.Y. State Plane (NAD-83)(86) on the herein Easement Parcel were derived by solar.. 0° 11' 19" from Filed Map azimuth.
3. Any alteration or addition to this survey is a violation of Section 7209 of The New York State Education Law, except as per Section 7209-Subdivision 2.

REFERENCES:

1. "Subdivision Map Levittown Section 20..." filed in the NCCO, Division of Land Records on Feb. 28, 1951 as Map No. 5164.
2. Nassau County Land & Tax Map Block 339, Section 51 Town of Hempstead
3. Points found as shown.

NTS

SCALE: 1" = 20'	HIRANI ENGINEERING & LAND SURVEYING, P.C. 47 MINEOLA BLVD., 2ND FLOOR MINEOLA, N.Y. 11501 T (516) 248-1010 F (516) 248-9018 HIRANI
OWNER:	U.S DEPT. OF NAVY
CONTRACTOR:	TETRA TECH NUS
SUBJECT:	EASEMENT FOR OUTPOST MONITORING WELLS BP-OW 4-1 (D-3) & BP-OW 4-2 (D-3)
DATE DRAWN:	
DATE OF SURVEY:	
CONTRACT:	
SHEET NO. 1 OF 1	

OUTPOST MONITORING WELL
DRILLING CONTINGENCY PROCEDURES
NWIRP BETHPAGE, NEW YORK

As a normal practice, the deepest well at each cluster will be drilled and installed first. Split spoon samples will collected throughout the boring and across the deepest screen interval as indicated in Table 1. Based on regional data, significant confining unit (fine-grained materials greater than 4 feet thick) should not be present at the planned screen interval and therefore the geophysical log will be conducted to confirm the absence of clay unit across the screened interval, and the screen and well will be installed as planned.

However, if significant clay units are encountered within the planned screen intervals (greater than 20 feet thick), then the following contingencies will be implemented.

Contingencies for the First Monitoring Well Installed in each Cluster

1.0 Based on split spoon sample results, clay and/or clay lenses are prominent throughout the target screen interval (i.e. a 20 foot thick or greater silty/sandy zone is not present within the target screen interval, see Table 1), then

- Continue drilling downward while collecting split spoon samples every five feet, until a minimum of a 20 foot sandy zone is encountered, but proceed no further than 50 feet beyond the bottom of the target screen zone (deepest well only).
- Run geophysical log (deepest well only).
- Screen length is to be a minimum of 20 feet and a maximum of 40 feet, and placed in a sandy zone. The top of the screen shall not be higher than the top of the target screen interval and the bottom of the screen shall not be lower than 50 feet below the bottom of the target screen interval.
- If a screen interval cannot be selected as indicated above, then identify the next deepest well that can be installed in that cluster. Backfill the boring to that depth with bentonite to seal the bottom of the boring and then install the well. The decision on where to place the deepest well will not be made in the field.

2.0 Based on split spoon sample results, a significant clay unit (s) is present in the top half of the target screen interval and 10 to 20 feet of sand is present in the bottom portion of the target screen interval. The screen will be then placed below the clay unit. To determine the screen interval,

- Continue drilling and collecting split spoons to determine if the sandy unit continues downward (deepest well only). Stop when a significant clay unit or the equivalent of sand sufficient for a 40 foot screen interval is encountered.
- Run geophysical log (deepest well only).
- Install well in sandy zone. The screen length may be adjusted to 20 to 40 feet to fit in sandy zone.

3.0 Based on split spoon sample results, a significant clay unit (s) is present in the bottom half of the target screen interval. The well screen will be installed above the clay unit. To determine the screen interval,

- Stop drilling at bottom of target depth.
- Run geophysical log (deepest well only)
- Install well in sandy zone above clay unit, and shorten well screen (but no less than 20 feet) so that the top of the screen is not higher than the top of the target screen interval.

4.0 Based on split spoon sample results, a significant clay unit is present in the middle portion of the target screen interval and a viable sandy unit is present above and below the clay unit, such that the selection of one unit over the other can not be decided with the available data.

- Install next shallowest well as identified under Contingency 1 above.
- Re-drill the boring and collect two temporary monitoring well samples to help determine the screen interval. One water sample will be collected above the clay unit and one water sample will be collected below the clay unit. The screen interval will be placed in the interval with the highest detected site VOC.

If significant clay units are detected in the less deep monitoring well screen intervals, then the contingencies listed above will apply, except that well screens may be shortened so as to not over lap will the deeper well screens. Water samples in the boring will be collected only in the event that geophysical data cannot be used to determine screen intervals.